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ABSTRACT

This report gives the results obtained in the semantic and syntactic analysis of the Japanese particles "de," "ni," "e," and "wo" in comparison to their equivalents in English, German, and Spanish. The study is based on the so-called "Correlational Analysis" as proposed by Ernst von Glaserfeld. The combinations of distinctive semantic features of the "correlata" with the relations are summarized in tables. A detailed and diagramed description is given of two examples showing the transition from any of the four languages to any of the others in the translation process concerning the particles involved. The model is based on the logical functions of conjunction, dejunction, and disjunction as suggested by A. Hoppe. The Japanese particles--particularly "de," "ni," and "wo"--have a wide semantic range. This will be a problem in machine translation but could be approached through coding the distinctive correlational features of the words in the dictionary and through adequate programming for the machine translation process. On the other hand, this lack of linguistic explicitness forces the speaker and hearer of Japanese to extract considerably more information from the context, both linguistic and social, than the speakers of the other three languages to achieve comprehension in the communication process. (Authors/DO)

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COMPARATIVE ANALYSIS OF LANGUAGES FOR MACHINE PROCESSING

Ernesto Zierer, Kisang Lee, Alun L. W. Rees,
Anbal Sánchez, Socorro Goicochea

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Errata

Page	Line		
i	3	replace:	to by: with
iii	12	replace:	Paricle by: Particle
4	5	replace:	banana by: bananas
6	10	remove:	the
7	7	insert:	a comma after: Next and: study
		remove:	the comma after: i.e.
	9	insert:	a comma after: English
11	13	insert:	a comma after: space
	18	remove:	classes
13	5-6	rewrite as:	Though a more profound study of such expressions is also possible in terms of correlational analysis...
	8	insert:	the after: in
15	22	replace:	considerably by: very
19	7-8	place:	further after: be
	24	insert:	the after: in
22	9	remove:	the comma after: i.e.
23	9	insert:	, in after: symbol
		insert:	a comma after: dpts
27	117	insert:	the after: in
29	12-13	place:	only after: solved
32	1	replace:	collectivististic by: collectivistic
	3	insert:	a comma after: English
		insert:	a comma after: Spanish
41	24	replace:	from by: after
54	3	rewrite as:	"Even though they call it autumn, it's still warm."
60	14	insert:	the after: of
66	19	replace:	for by: to
72	3	replace:	fault by: faults
73	14	replace:	in the by: on his
81	1	replace:	Foot-Notes by: Foot-notes

A B S T R A C T

This report gives the results obtained in the semantic and syntactic analysis of the Japanese particles DE, NI, E, and WO in comparison to their equivalents in English, German, and Spanish. The study is based on the so-called "Correlational Analysis" as proposed by Ernst von Glaserfeld.

The combinations of distinctive semantic features of the correlata with the relations are summarized in tables. A detailed and diagramed description is given of two examples showing the transition from any of the four languages to any of the others in the translation process concerning the particles involved. The model is based on the logical functions of conjunction, dejunction, and disjunction as suggested by A. Hoppe.

The Japanese particles - particularly DE, NI, and WO - have a wide semantic range. This will be a problem in machine translation but could be approached through coding the distinctive correlational features of the words in the dictionary and through adequate programming for the machine translation process.

On the other hand, this lack of linguistic explicitness forces the speaker and hearer of Japanese to extract considerably more information from the context - both linguistic and social - than the speakers of the other three languages to achieve comprehension in the communication process.

A C K N O W L E D G E M E N T S

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COMPARATIVE ANALYSIS OF LANGUAGES FOR MACHINE PROCESSING

Semantic Analysis of Japanese Particles with Reference to English, German, and Spanish

1. Purpose of the Study

One of the major problems in machine translation lies in the analysis of the source language, particularly when semantic aspects are involved. Polysemy plays an important role especially when the relations between words are less explicit in the source language than in the target language.

This difference in explicitness is, of course, relative. The native speaker of the target language expects in the source language the same or similar explicitness he is accustomed to in his mother tongue. This difference, as well as others referring to the "Weltbild" of the language concerned, may be explained in terms of psycholinguistics and sociolinguistics. In this respect, the Japanese language is a particularly interesting case.

There is also the problem that the selection of particles in Japanese is conditioned by syntactic and semantic criteria different from the ones that are valid in the target language or that are irrelevant in the selection of linguistic forms.

In Japanese, as in other languages with a low degree of inflection, the particle system plays a very important role in establishing

syntactic and semantic coherences. Finding the equivalents in other languages for such a particle system is a powerful means of describing it more precisely and of uncovering at the same time a variety of aspects so far neglected.

This study will deal with those Japanese particles that function as syntactic markers signalling basic parts of speech, and with those that express other relations. Their analysis shall permit us:

a) To find their proper equivalents in ENGLISH, GERMAN and SPANISH,

b) To learn more about Japanese from the point of view of psycholinguistics and sociolinguistics.

2. Methods of Procedure

The analysis of the particles is based on the so-called CORRELATIONAL ANALYSIS. [1)]

The particles function as so-called explicit correlators, establishing [a/] relation of a specific kind between at least two correlata.

We shall extract from the correlata those syntactic and/or semantic features which, together with the specific relation involved, explain the presence of a certain particle, thereby making it possible to find the equivalents in English, German and Spanish:

Example 1: Hakone DE tomodachi ni aimashita.[2)]

(Hakone) (at) (friend) (part.) (I met)

1st correlatum correlator 2nd correlatum

English: "I met a friend at Hokone."

Semantic Features:

1st correlatum: Small urban area

2nd correlatum: Event

Relation: Indication of place

Example 2: Tokyo DE tomodachi ni aimashita.

English: "I met a friend in Tokyo."

Semantic Features:

1st correlatum: Large urban area

2nd correlatum: Event

Relation: Indication of place

Comparing example 2 with example 1, we notice that the selection of the proper equivalent in English depends upon the distinctive semantic features "large urban area" and "small urban area" of the first correlatum.

This distinction, however, is not relevant in German nor in Spanish:

Ex. 1: German: "Ich traf in Hakone einen Freund."

Spanish: "Me encontré con un amigo en Hokone."

Ex. 2: German: "Ich traf in Tokyo einen Freund."

Spanish: "Me encontré con un amigo en Tokyo."

Example 3: Banana DE tsukutta sake wa

(banana) (from) (made) (liqueur) (part.)

English: "Liqueur made from banana."

Semantic Features:

1st C.: Noun indicating material

2nd C.: Verb indicating activity

Relat.: Indication of material involved in a process of transforming

Example 4: Ki DE tsukutta teeburu wa

(wood) (of) (made) (table) (part.)

English: "A table made of wood."

Semantic Features:

1st C.: Noun indicating material

2nd C.: Verb indicating activity

Relat.: Indication of material of which something is made.

Comparing Ex. 3 with Ex. 4, we notice that the selection of the corresponding preposition in English depends upon the type of relation. The distinctive semantic feature is "indication of material involved in a process of transforming" versus "material of which something is made".

This distinction is not relevant in German nor in Spanish:

Ex. 3: G.: "Aus Bananen hergestell Likör."

S.: "Licor hecho de plátanos."

Ex. 4. G.: "Ein Tisch, der aus Holz gemacht ist."

S.: "Una mesa hecha de madera"

In the present research no example could be found in which the same Japanese particle would have a different equivalent in one of the other three languages in consequence of changing only the semantic features of the 2nd correlatum. This, however, does not necessarily imply that further search would not yield such cases.

The examples given above illustrate the fact that there is a lower degree of explicitness in Japanese where there is a higher degree in this respect in the other three languages. On the other hand, as we have mentioned in Paragraph 1, there are also cases where there is a higher degree of explicitness in Japanese than in the other languages:

Example 5: "Heya DE asobu."

(room) (in) (play)

English: "To play in the room"

German : "in Zimmer spielen"

Spanish: "jugar en el cuarto"

Semantic Features:

1st C.: Noun indicating covered place

2nd C.: Activity

R. : Indication of place

Example 6: "Heya NI iru."
(room) (in) ("be")

English: "To be in the room."

German : "Im Zimmer sein."

Spanish: "Estar en el cuarto."

Semantic Features:

1st C.: Noun indicating covered place

2nd C.: State

R. : Indication of place

Comparing the two examples with each other, we notice that the Japanese makes a distinction where English (as well as the other 2 languages) does not. The selection of the proper particle in Japanese is determined by the semantic nature of the 2nd correlatum.

The following procedure was used in the research: The examples extracted from spoken and written Japanese were classified by their particles, then analysed in the way specified above, and provided with their corresponding equivalents in English, German and Spanish.

The analysis has been carried out in different steps:

(1) A very detailed semantic description of the two correlata and the relation was made for all the occurrences of a given particle. In this first step, over-differentiation was rather frequent.

(2) The descriptions of the particle occurrences in terms of correlata and relation were then compared with one other in order to

discover the distinctive correlational features that account for the different equivalents in the other languages. In this way the over-differentiation was gradually reduced.

A general matrix corresponding to each particle shows the combinations of types of correlata and relations encounterd. However, it should be noted that completeness of this matrix is not claimed.

Next all those uses of the particle under study i. e., their descriptions in terms of correlata and relation that had the same equivalent in English were grouped together. Similar classifications were made with respect to the other two languages.

Repetitions of the same type of use were eliminated.

3. Formal Treatment of the Problem

Let

$$D_p^{(e)} = \left\{ d_{p;1}^{(e)} , d_{p;2}^{(e)} , \ldots , d_{p;n}^{(e)} \right\}$$

be the set of all different equivalents in English of the Japanese particle. Analogically, we have the following sets of equivalents in German and Spanish for the same particle:

$$D_p^{(g)} = \left\{ d_{p;1}^{(g)} , d_{p;2}^{(g)} , \ldots , d_{p;o}^{(g)} \right\}$$

$$D_p^{(s)} = \left\{ d_{p;1}^{(s)} , d_{p;2}^{(s)} , \ldots , d_{p;p}^{(s)} \right\}$$

We define a set

$$A_p = \{a_1, a_2, \ldots, a_k\}$$

of distinctive semantic features of the 1st correlatum;

a set

$$B_p = \{b_1, b_2, \ldots, b_w\}$$

of distinctive semantic features of the 2nd correlatum; and

a set

$$C_p = \{c_1, c_2, \ldots, c_m\}$$

of different relations.

Any use _i_ of the particle _p_ may be defined as a triple

$$n_{p;i} = \langle a_{p;g}, b_{p;h}, c_{p;j} \rangle$$

Specifically, we get a family of sets

$$p^{(d)^{(e)}} = \left\{ N_{p;1}^{(d_1)^{(e)}}, N_{p;2}^{(d_2)^{(e)}}, \ldots, N_{p;n}^{(d_n)^{(e)}} \right\}$$

in which set $N_{p;1}^{(d_1)^{(e)}}$ stands for the different uses

$$\left\{ n_{p;1}^{(d_1)^{(e)}}, n_{p;2}^{(d_1)^{(e)}}, n_{p;q}^{(d_2)^{(e)}}, \text{ where } n_{pii} \neq n_{pij} \text{ if } i \neq j \text{ and } i,j=1,2\ldots q \right\}$$

of the particle _p_ which have d_1 as an equivalent in English:

$N_{p;2}^{(d_2)^{(e)}}$, for the uses $\left\{ n_{p;1}^{(d_2)^{(e)}}, n_{p;2}^{(d_2)^{(e)}}, \ldots, n_{p;r}^{(d_2)^{(e)}} \right\}$

of the particle _p_ which have d_2 as an equivalent in English, etc.

The uses of the particle _p_ are defined as the triples

$$n_{p;1}^{(d_1)^{(e)}} = \langle a_x^{(d_1)^{(e)}} ; b_{x'}^{(d_1)^{(e)}} ; c_{x''}^{(d_1)^{(e)}} \rangle$$

$$n_{p;2}^{(d_1)^{(e)}} = \langle a_y^{(d_1)^{(e)}} ; b_{y'}^{(d_1)^{(e)}} ; c_{y''}^{(d_1)^{(e)}} \rangle$$

. = .

. = .

. = .

$$n_{p;q}^{(d_1)^{(e)}} = \langle a_z^{(d_1)^{(e)}} ; b_{z'}^{(d_1)^{(e)}} ; c_{z''}^{(d_1)^{(e)}} \rangle$$

Analogical notations can be established with respect to the equivalents in German and Spanish.

A correlation $n_{p;1}$ may be represented as a point within a 3-dimensional space, its position being determined by the triple $(a_g; b_h; c_j)$.

We shall call this space a "correlational space". In the case of there being different types of correlations involving the same particle but which all have the same type of equivalent in the other language, the different uses may be represented by a curve in this space.

Example 7:

In the expression

"Kare wa shoojiki de kimben desu."

"He is honest and diligent."

the correlation is the following:

1st correlatum: Predicative adjective: Index Number : 15

2nd correlatum: Predicative adjective: I.Nº : 5

Relation Co-ordinating conjunction: I.Nº : 21

The point corresponding to its correlation is defined by:

$$n_{1;1}^{(d_3)(e)} = (a_{15}; b_5; c_{21})$$

and has been entered into the coordinate system shown as Fig. 1 where the three axes represent the sets A, B, C.

Example 8:

"Kaminari de nemurenakatta".

"I couldn't sleep because of the thunder."

1st C.: Concrete object phenomenon: I.Nº : 7

2nd C.: Process : I.Nº : 1

Re. : Cause : I.Nº : 15

Example 9:

"Ame de ikanakatta."

"I couldn't go because of the rain."

1st C.: Concrete object phenomenon: I.Nº : 7

2nd C.: Locomotive activity: I.Nº : 3

Re. : Cause: I.Nº : 15

The points corresponding to these two correlations are:

$$n_{1;1}^{(d_6)^{(e)}} = (a_7; b_1; c_{15})$$

$$n_{1;2}^{(d_6)^{(e)}} = (a_7; b_3; c_{15})$$

which permit us to draw the curve in the 3-dimensional space that can be seen in Fig. 1.

The set $N_{p;t}^{(d_t)^{(e)}}$ then describes in the 3-dimensional correlation space the English equivalent $d_{p;t}^{(e)}$ of the particle p in the form of a point or a curve according to whether the number of elements of the set is equal to 1 or larger than 1.

4. The Particle DE

4.1. Preliminaries

There can be distinguished three basic classes though partly overlapping classes of this particle:

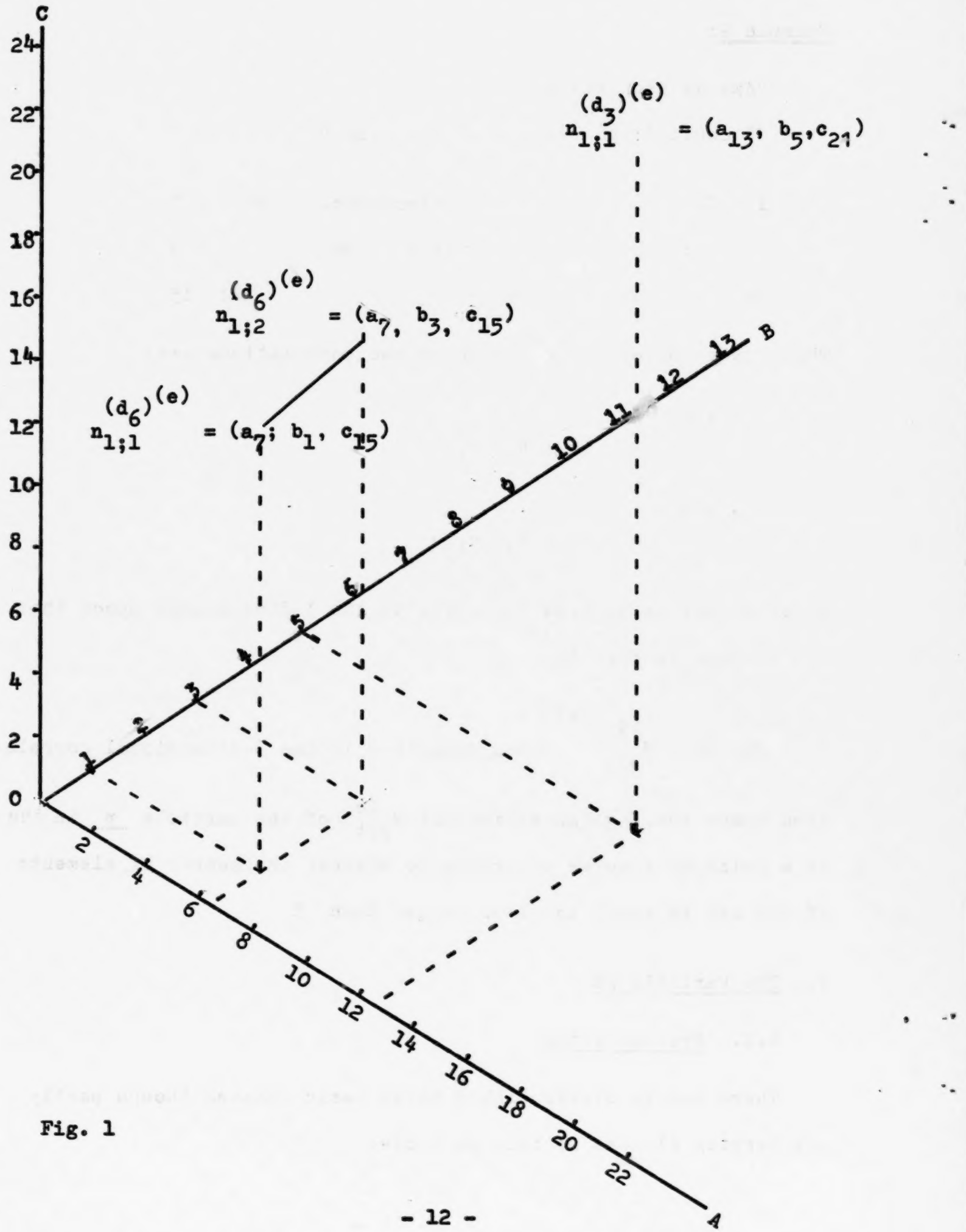

C
24
22
20
18
16
14
12
10
8
6
4
2
0
$(d_3)^{(e)}$ $n_{1;1}$ = (a_{13}, b_5, c_{21})
$(d_6)^{(e)}$ $n_{1;2}$ = (a_7, b_3, c_{15})
$(d_6)^{(e)}$ $n_{1;1}$ = $(a_7; b_1, c_{15})$
B
A
1
2
3
4
5
6
7
8
9
10
11
12
13
2
4
6
8
10
12
14
16
18
20
22

Fig. 1

a) Integrating an adverbial or an idiomatic expression as in:

"ato de" : "afterwards"

"hitome de" : "at a glance"

"doko de mo" : "anywhere

Though a more profound study in terms of correlational analysis is also possible of such expressions, they are more likely to be listed as such in the dictionary with their equivalents in the output language in case of machine processing;

b) As an auxiliary element integrating certain syntactic constructions or pronominal expressions, e.g.:

Negative classes such as:

"Ano kata wa sensei de wa arimasen": "He isn't a teacher".

"Shinai de kudasai" :"Don't do it."

"Nanni mo iwanai de itte shimatta." :

"He went away without saying a word."

Polite expressions:

"Ni ji de gozaimasu". : "It is two o'clock."

Pronouns:

"dare de mo" : "anybody"

"nan de mo" : "anything"

These cases are dealt with in any good handbook on Japanese grammar and hence do not form part of this study.

c) Functioning as an explicit correlator in uses different from a) and b).

The analysis will be concerned only with these uses of the particle.

4.2. Results

The analysis of 110 occurrences of constructions with DE as an explicit correlator in written and spoken Japanese has shown that the particle has a variety of different equivalents in English, expressing different types of correlation.

For the particle DE (p =1) a set

$$D_1^{(e)} = \left\{ d_{1;1}^{(e)} , \; d_{1;2}^{(e)} , \; \ldots , \; d_{1;18}^{(e)} \right\}$$

of different equivalents in English, including the equivalent Ø has been found. The distinctive features of the correlata and the relation are given in Appendix 1.

In the list shown as Appendix 2 only those occurences of the particle DE having different correlation triples have been included. They are presented as a list of the English equivalents arranged in alphabetical order.

The matrix given in Appendix 3 summarizes the correlation triples found.

The graph shown as Appendix 4 illustrates how a mechanism would produce the English equivalents on the basis of binary decisions.

The symbol at each final node of the graph gives as subscripts before the dash the number of the English equivalent, following the dash, the number of the example, and in parenthesis the number of binary decisions necessary to produce the equivalent.

Example: $d_{14-44(9)}$

From the graph it is apparent that we can form the following special sets:

Set M $= \{m_1, m_2, \ldots, m_5\}$ of distinctive semantic features of the 2nd correlatum.

Set $S = \{S_1, S_2, \ldots, S_5\}$ of sets of distinctive semantic features of the 1st correlatum that may be combined with m_1, m_2, ..., m_5 respectively.

Set $T = \{T_1, T_2, \ldots, T_5\}$ of sets of distinctive relations that may be combined with m_1, m_2, ..., m_5 respectively, such that S_k and T_k correspond to m_k, and $s_v^{(k)} \in S_k$ and $t_v^{(k)} \in T_k$.

The graph can then be produced according to the simplified algorithm given as appendix 5.

Regarding the other two languages, the result was the following:

German: 19 different equivalents.

Spanish: 15 different equivalents.

The research so far has shown that the Japanese particle DE has a considerably wide semantic range. Therefore, the correlation brought about by the particle has to be made explicit in order to choose the

proper equivalents in the other three languages.

The speakers of the three Indo-European languages expect a higher degree of explicitness with respect to the functions of the particle DE and hence will have a special problem in handling this particle.

5. The Particle NI

The analysis has been concerned only with the use of NI as an explicit particle. The analysis of 119 occurrences of constructions with NI as an explicit correlator in written and spoken Japanese has shown that the particle has a variety of different equivalents in English, German and Spanish, expressing different types of correlations. For the particle NI;

21 different English equivalents,

20 different German equivalents, and

20 different Spanish equivalents have been found.

Appendix 6 gives the list of only those occurrences of the particle NI having different correlation triples. The matrix given in Appendix 7 summarizes the correlation triples found.

The larger semantic range of the particle NI makes it necessary to make the meaning of this particle explicit in order to choose the proper equivalents in the other languages. The same problem, pointed out when dealing with the particle DE, will exist for the speaker of the three Indo-European languages also with regard to NI.

There is also a class of verb that requires the particle NI, as for example "ni niru" (to look like), "ni naru" (to become), etc.

6. The Particle E

The analysis of 95 occurrences of constructions with 'E' as an explicit correlator in written and spoken Japanese has shown that the particle has considerably fewer different equivalents in English, German and Spanish than the particles DE and NI. For this particle there have been found:

9 different English equivalents,

8 different German equivalents,

6 different Spanish equivalents.

Appendix 8 gives the list of only those occurrences of the the particle 'E' that have different correlation triples. The matrix given as Appendix 9 summarizes the correlation triples found. This particle has a considerably more restricted semantic range. In many instances E may be replaced by NI: For example, in sentence (13) we can replace E by NI.

"Asu Oosaka E iku tsumori da."

"Asu Oosaka Ni iku tsumori da."

A slight change in meaning may occur in this substitution. While the meaning of the sentence with E implies also the idea of "going towards", i.e. a direction of an action, this feature is no longer contained in the sentence with NI. Thus NI refers mainly to "point in space", while E emphasizes "direction". This distinction, however, is usually neglected in spoken language. [3)]

7. The Particle WO

The analysis of 125 occurrences of constructions with WO as an explicit correlator in written and spoken Japanese has shown a wide semantic range of this particle. For this particle there have been found:

16 different English equivalents,

14 different German equivalents, and

8 different Spanish equivalents.

Appendix 10 gives the list of only those occurrences of the particle WO that have different correlation triples or those which though having identical correlation triples have different equivalents in any of the other three languages.

Frequently the Japanese particle implies a different semantic structure as for example in

(1a) "Boku wa Taroo no atama wo utte yatta."

where WO expresses clearly that "atama" is the direct target of the action expressed by "utte yatta", and further, the relation of "belong" (or possession) exists between "atama" and "Taroo", expressed by the particle NO. In English, German and Spanish:

(1b) "I hit Taroo on the head."

(1c) "Ich schlug Taroo auf den Kopf."

(1d) "Pegué Taroo en la cabeza."

The relation of belonging is modified into what is called in German a "Zuwendung" (turning towards). This situation occurs when an action

of an agent is directed at a person without his being considered as the direct target (object) of the action.[4] The person is rather a passive "participant" in the action. In the example given, "Taroo" has become this participant, and what has been the direct target of action - "atama" has been converted into a prepositional phrase indicating "place" combined with "direction". The problem can further be elucidated by means of passive transformations. Japanese admits two forms of the passive voice:

(1a') "Taroo wa boku ni atama wo utareta."

(1a") "Taroo no atama wa boku ni utareta."

the first being more usual than the second. In the other three languages the "participant" in the action becomes the grammatical subject in the passive construction while the prepositional phrase remains unchanged. In Japanese, either the direct relation between agent and the target of the action remains unchanged or the grammatical object may become the grammatical subject.

(1b') "Taroo was hit on the head by me."

(1c') "Taroo wurde von mir auf den Kopf geschlagen."

(1d') "Taroo fue golpeado en la cabeza por mí."

German has a peculiarity of its own, admitting the participant in the dative form:

(1c") "Ich schlug dem Jungen auf den Kopf."

(1c"') "Dem Jungen wurde von mir auf den Kopf geschlagen."

In latter sentence, strictly speaking, there is no grammatical subject, for the sentence does not contain a noun or pronoun in the nominative

case.

(2a) "Kare wa doroboo no ude wo tsukamaeta."

(2b) "He caught the thief by the arm."

There is again the relation of belonging in the Japanese sentence between "doroboo" and "ude", signalled by the particle NO, "ude" being the direct target of the action, while in the other three languages a prepositional phrase expressing "means" is the equivalent of "ude".

The matrix given in Appendix 11 summarizes the correlation triples found.

8. <u>The Problem of Particle Analysis seen from the Standpoint of Information Theory.</u>[5)]

To view the particle analysis also from the standpoint of information theory, the corresponding values were calculated for the particle DE with respect to its English equivalents:

Amount of information of equivalent d_i

$H_{d_i} = ld \frac{1}{P}$, in which ld is the logarithm to the base 2, and P_i the relative frequency of the equivalent, i.

<u>Contribution</u> of information amount of equivalent i:

$C = N P_i \; ld \frac{1}{P_i}$, in which N is the total number of equivalents.

Total amount of information:

$$H_t = \sum_{i=1}^{17} N \; P_i \; ld \frac{1}{P_1} = 168.04 \text{ bits.}$$

Average amount of information per equivalent:

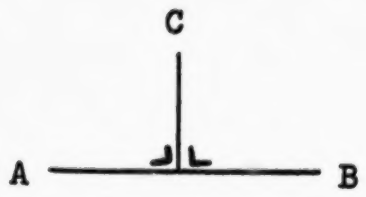
$$H_i = \sum_{i=1}^{17} P_i \; ld \frac{1}{P_i} = 3.37 \text{ bits.}$$

9. The Particles in Machine Translation

As has already been pointed out, the semantic range of the Japanese particle is considerably wider than that of its equivalents in the other three languages. This considerably lower degree of explicitness of the relations between the correlata in Japanese increases the problem of assigning the particle its corresponding equivalents in the other languages. However, this difficulty can be largely overcome by coding the distinctive semantic features of the correlata in the dictionary, i.e., each word that may enter into a correlation with a particle will have as additional information its distinctive correlation features.[6] Having determined the distinctive semantic features of the two correlata, the range of ambiguities is considerably reduced.

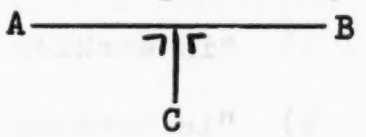
A total elimination of the ambiguities based exclusively on particle analysis is not possible in all cases, for the third variable - the relation - cannot always be coded in the dictionary. The ambiguities must then be eliminated by means of other information stemming from the text.

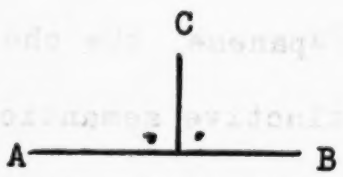
In the diagram shown in Appendix 12 the combinations of the distinctive semantic features of the correlata with respect to the English equivalents of particle DE are represented in the form of a circuit based on the logical operation of conjunction and exclusive disjunction. In the diagram these operations are represented by the following symbols:[7]

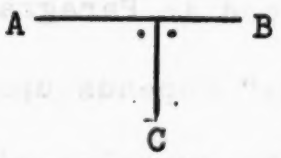
1) 

This symbol read from bottom to top indicates that information can continue to C only if information proceeds from A and from B. (Conjunction; logical product: 1 + 1 = 1).

The same symbol may be read from top to bottom, which means that information proceeding from C must continue to A and to B (logical dejunction.) The same symbol may appear also in reverse position; where it has exactly the same meaning.



2) 



This symbol which the angles have been replaced by dots means that information will continue to C if information proceeds from A, but not from B at the same time, or from B, but not from A at the same time. (Exclusive disjunction: 1 + 1 = 0; 1 + 0 = 1; 0 + 1 = 1). In the diagram the two symbols are repeated as many times as necessary to produce all combinations allowed according to the semantic analysis previously made.

The diagram in Appendix 13 illustrates the transition from the particles NI and DE in given verb-phrases to their equivalents in English:

Input sentences:

1) "Hakone ni sunde imasu."

2) "Tokyo ni sunde imasu."

3) "Hakone de hataraite imasu."

4) "Tokyo de hataraite imasu."

Corresponding output phrases:

1) "is living at Hakone."

2) "is living in Tokyo."

3) "is working at Hakone."

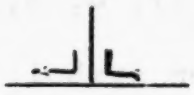
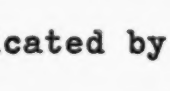
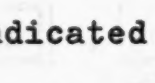
4) "is working in Tokyo."

As already explained in Paragraph 2, in Japanese, the choice of the particle to "place" depends upon the distinctive semantic feature of the verb: In the examples given above we have "expression of state" against "expression of activity". This distinction is irrelevant in English. On the other hand, the distinction of "small urban area" as against "large urban area" is relevant for the preposition selection in English while it is not in Japanese. In the diagram we distinguish two levels: the form level which contains all forms starting from words up to syntactic phenomena, and the content level, which contains the so-called grammatical content factors, which in our case are the distinctive semantic features that determine the selection of particles in the two languages.

The whole process, of which the diagram is a simplified representation, is to be considered as a dynamic phenomenon and its phases may be described as follows:

a) The Japanese phrase is to be considered as given:

b) At the form level corresponding to the Japanese phrase,

the symbol  means analysis of linguistic forms into distinctive semantic features, and eventually into paths leading to connexions with other lexies cooperating to form constituents of a higher hierarchy still at the form level. Thus N - standing for the noun HA (Hakone) - is analysed into the SDF (5) - standing for "small urban area" - and into a path leading to a conjunction with a path stemming either from NI or from DE (but not from both at the same time), which produces NP (noun phrase) at the form level. This conjunction is indicated by the symbol  . Notice also that the HA-Ns of the phrases of the other three languages are connected to (5), which is indicated by the conjunction symbol  . N standing for NY (New York) is analysed into the DSF [6] (large urban area) and into a path leading to the conjunction with a path stemming either from NI or from DE, producing NP. The NY-Ns of the phrases of the other three languages are equally connected to [6]. NI is broken down into two alternative paths leading to NP at the form level and to the pair [6] [1] of SDFs "existence, expression of state" and "confined space". Notice also that an alternative path leads from

the symbol ⊥ to the set of DSFs={35, 34, 31, 48, 36, 33, 32, 30, 29, 22, 38, ...}, through subsequent application of the same type of symbol.

DE-PREP is analysed in a similar way as NI-PREP, one of the two paths leading, however, to the pair [2] [1] . Notice that there is also an alternative path leading to the set of DSF ={17, 8, 3, 2, ... }, through subsequent application of the disjunction symbol.

SUMU-V is analysed into one path leading to VP, and one leading to the DSF [6] (existence, expression of state).

HATARAKU-V is similarly analysed, with one path leading, however, to the DSF [2] (expression of activity).

The four equivalent expressions are adequately connected through the core containing the distinctive semantic features. It is noted that the diagram is not complete since it does not provide for the final output forms.

In the diagram we have entered in a box combinations of the DSFs that determine the particle selection: [6 1], [2 1] for the Japanese particles: [1 5] and [1 22] for the English equivalents.

The whole process as presented by the model can then be described as follows:

The linguistic forms are analysed to discover the correlational situation. The distinctive semantic features of the words must be provided by the dictionary. Next, a correlational formula is produced that contains the combination of the factors that conditions the input form analysed. [8)]

The correlational formula is then connected to the distinctive semantic features of the output languages either directly or after having been transformed to take into account the distinctive semantic features characteristic of the output language. In our example the correlational formula corresponding to the Japanese input form has to be changed in order to produce the English output form, and vice versa.

The diagram given as Fig. 2 shows in a simplified form how the combinations of the correlational formulas are produced on the basis of the two logical operations of conjunction and exclusive disjunction. The basic idea of the model is that the translation process does not proceed from form to form nor from syntax to syntax but leads via correlational formulas to the output language. [9)]

In this translation procedure the correlation formulas of the input language must then be properly co-ordinated with its equivalent in the output language. It will thereby be often necessary to change certain distinctive semantic features for others, add new ones or eliminate existing ones. In Japanese sentences (1a) and(1b)

(1a) "Neko wa ishi de koresareta."

(1b) "Neko wa ishi ni korosareta."

the use of the two particles is indifferent. In both sentences "ishi" functions semantically as "material" or "instrument". Either of the two sentences may be translated into English as

(2a) "The cat was killed by a stone" or

(2b) "The cat was killed with a stone." each having a different

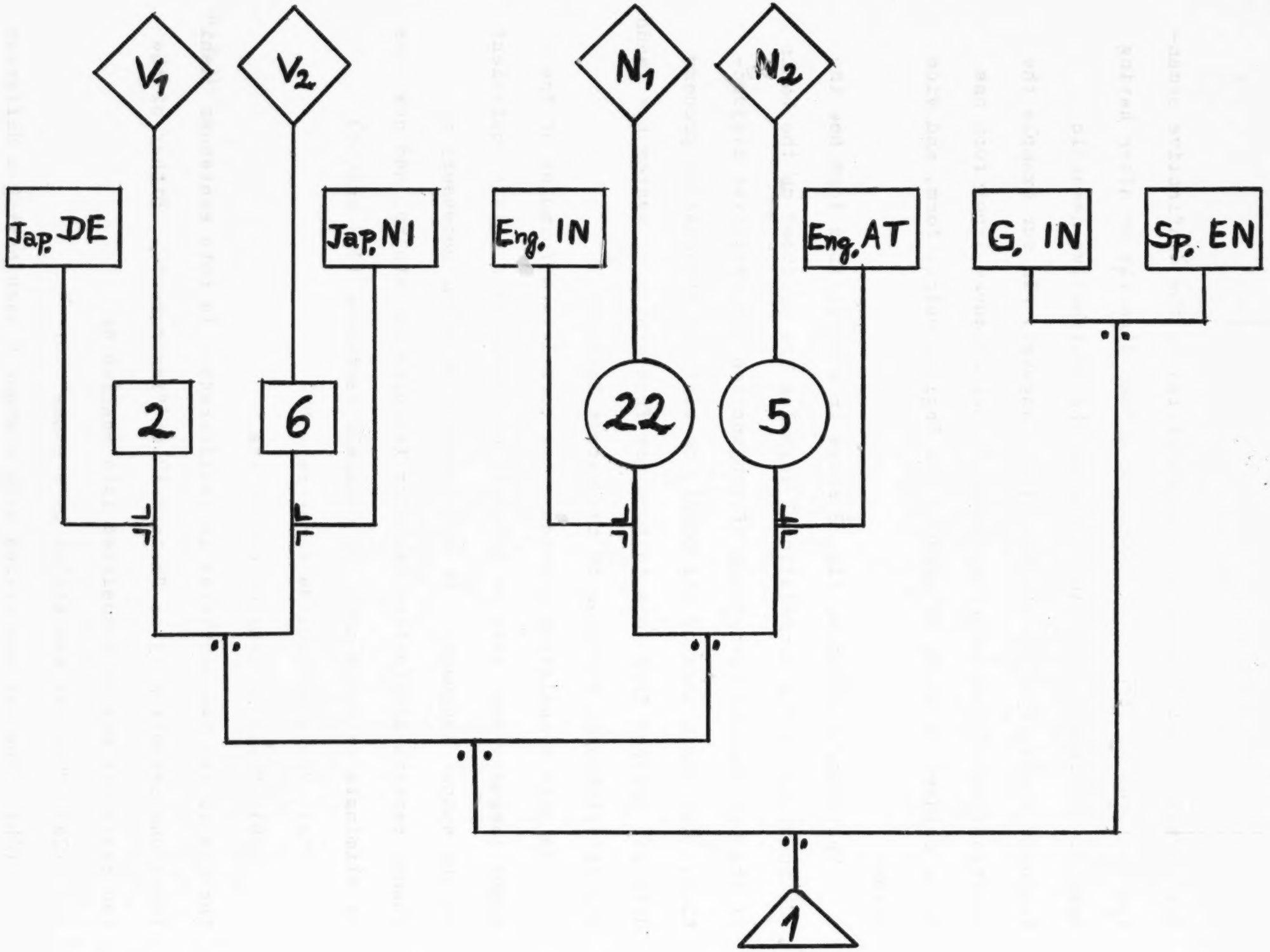


Fig. 2

meaning:

Sentence (2a) implies an agent that used the stone as an instrument to kill the cat, while in sentence (2b) the cat was killed by the stone, implying an accident. The same distinctions hold in German and Spanish:

(3a) "Die Katze wurde durch einen Stein getötet."

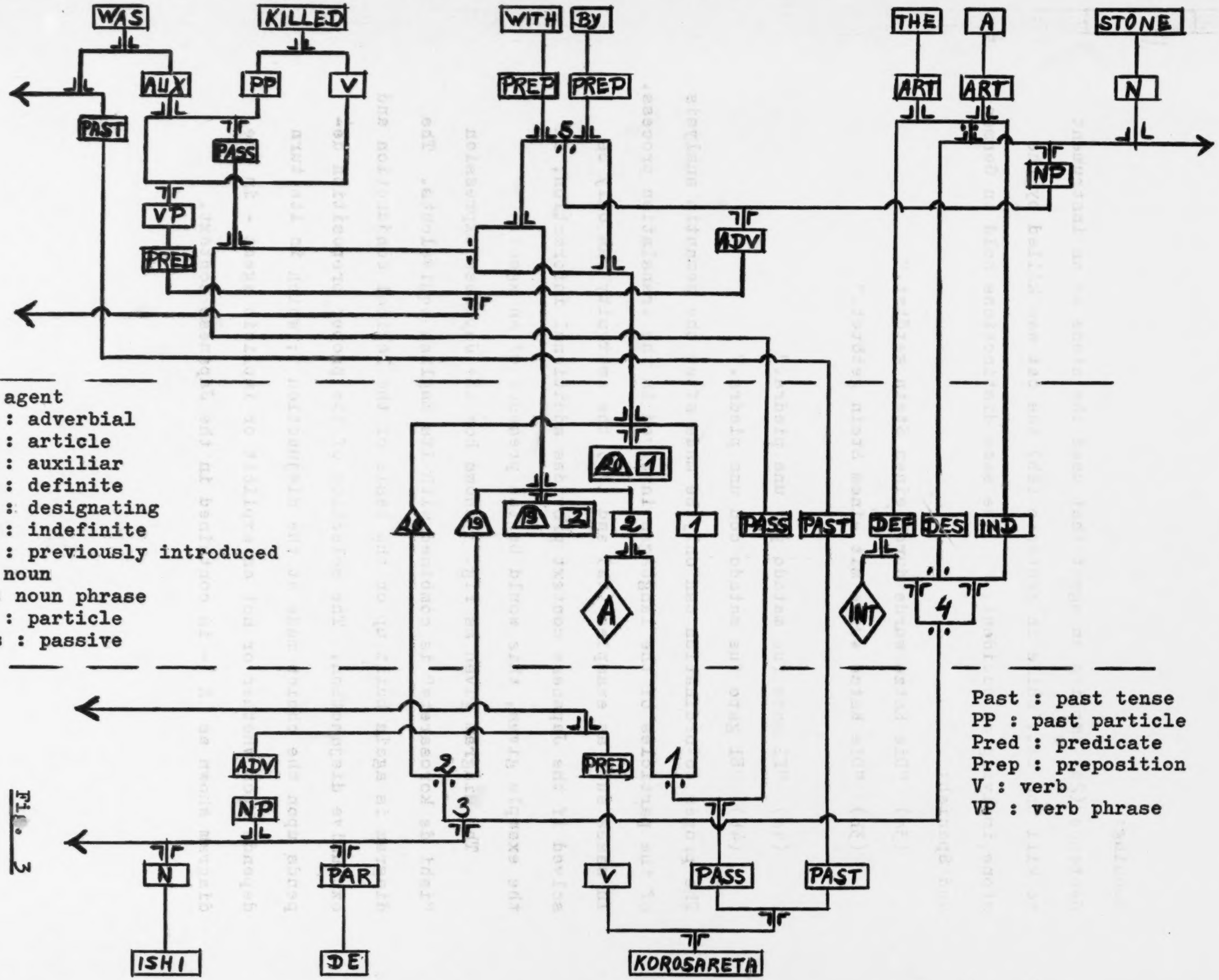
(3b) "Die Katze wurde mit einem Stein getötet."

(4a) "El gato fue matado por una piedra."

(4b) "El gato fue matado con una piedra."

The proper co-ordination can only be made after the semantic analysis of the particles of the languages involved in the translation process. In cases such as examples (1a) and (1b) the ambiguity can only be solved if the Japanese context provides additional information; in the example given, this would be the presence of an agent.

The diagram given as Fig. 3 shows how the Japanese expression "ishi de korosareta" is combined with its English equivalents. The diagram is again built up on the basis of the logical conjunction and exclusive disjunction. The selection of the proper preposition depends upon the choice made at the disjunction 1; which in its turn depends upon whether or not an explicit or implicit agent - in the diagram shown as A - is contained in the Japanese context.



A : agent
Adv : adverbial
Art : article
Aux : auxiliar
Def : definite
Des : designating
Ind : indefinite
Int : previously introduced
N : noun
NP : noun phrase
Par : particle
Pass : passive

Past : past tense
PP : past particle
Pred : predicate
Prep : preposition
V : verb
VP : verb phrase

Fig. 3

10. Summary

The correlational analysis of a total of 449 occurrences of the particles DE, NI, E, WO in spoken and written Japanese yielded the following findings:

a. Total number of different equivalents according to the following table:

	DE	NI	E	WO
English	17	21	9	16
German	19	20	8	14
Spanish	15	20	6	8

b. Total number of different distinctive semantic features:

(1) Of first correlatum: 14

(2) Of second correlatum: 9

c. Total number of different types of relations: 61

The wide semantic range of the particles implies a lower degree of explicitness of the semantic and syntactic relations in Japanese and hence becomes a major problem in translating from Japanese into English. An adequate solution of this problem would be a proper coding of the correlational features of the lexical items in the dictionary.

The lack of linguistic explicitness in Japanese forces the hearer and speaker of that language to extract considerably more information from the context than the speakers of the other three languages in order to go successfully through the verbal communication process. This phenomenon supports the contrast already pointed out on another occasion:

collectivististic attitude of the Japanese people against an individualistic attitude of the speakers of the other three languages. [10]
In English as well as in German and Spanish we want things said explicitly, and to be explicit is usually a feature of individualism.

APPENDIX 1

Distinctive Features of the Correlata and the Relation

1st Correlatum

1. Point of time in process or action; point in space; confined space; geographical region (country, continent etc.);
2. A period of time;
3. Non-motorised vehicle;
4. Activity; event; action;
5. Small urban area; site of action or location;
6. Gathering of human beings; group of human beings;
7. Concrete object or phenomenon;
8. Abstract expression;
9. Means of locomotion closely related with human being;
10. Social state of human being;
11. Complete sentence;
12. Numeral expression;
13. Noun-derived adjective;
14. Expression of value;
15. Physical state of human being;
16. Profession or occupation;
17. Limited space where people gather for specific purpose;
18. Motorised vehicle;
19. Longitudinal space (carrying traffic);
20. Formal gathering of people;

21. Time point;

22. Large urban area;

23. River, lake;

24. Cardinal direction.

2nd Correlatum

1. Process;

2. Activity; action;

3. Locomotive activity;

4. Complete sentence;

5. Predicative adjective or predicative adjectival expression;

6. Existence; expression of state;

7. Numeral expression;

8. Concrete object;

9. Passive locomotive activity (action);

Relation

1. Place;

2. Period needed for action or event;

3. Means of locomotion;

4. Idea of crossing a space;

5. Consequence;

6. Means;

7. Origin;

8. Social state of human being;

9. Specification of quantity;

10. Selection;

11. Specification of class;

12. Idea of exchange;

13. Indication of period that has passed;

14. Specification of duration of action or process;

15. Cause;

16. Specification of unit (time, weight, etc.)

17. Specification of time moment;

18. Condition (profession, occupation);

19. Instrument;

20. Material;

21. Co-ordinating conjunction;

22. Expression of time;

23. Purpose; destination;

24. Idea of adding

25. Aim of action or process

26. Functioning as;

27. Idea of separation;

28. Indirect object

29. Connection

30. Simultaneousness (of events);

31. Change of state;

32. Aim of action into space;

33. Aim of action: spatial proximity;

34. Action, process or existence on surface;

35. Vertical contact;

36. Aim of locomotive action;

37. Spatial proximity without contact;

38. Indicating direction;

39. Spatial proximity opposing 1st constituent to 2nd constituent;

40. Serving as a model;

41. Enumeration;

42. Proposition;

43. Resemblance;

44. Aim of action without reaching it;

45. Idea of missing;

46. Indirect object + direct object;

47. Distributive;

48. Quality;

49. Direct Object;

50. Locomotive action into space;

51. Production;

52. Aim of Action, bringing object towards actor;

53. Passive voice

54. Causative;

55. Concessive subordinating;

56. Idea of belonging;

57. Standing for missing clause;

58. Means forming part of the aim of action;

59. Replacing "that" affirmative clause;

60. Idea of crossing confined space;

61. Aim of process, bringing aim towards agent.

Appendix 2 DE

ABOUT, CONCERNING : d_1

$$N_{1;1}^{(e)} = n_{1;1}^{(d_1)(e)} = (8;2;15)$$

Ex.: (1) "Musume no mondai DE ukagaimashita."

English: "I came to see you concerning the problem of my daughter."

German equivalent of the particle: WEGEN, (BETREFFS)

Spanish equivalent: POR

AFTER : d_2

Ex.: (2) "Kekkon go ichinen DE otto to shibetsu shita." 2;1;13

"Her husband died after one year of marriage."

G.: NACH

S.: DESPUES

AND : d_3

Ex.: (3) "Kare wa shoojiki de kimben da." 13;5;21

"He is honest and diligent."

G.: UND

S.: Y

AS : d_4

Ex.: (4) "Kare wa yakusha de hataraku tsumori da." 16;2;18

"He has the intention of working as an actor."

G.: ALS

S.: COMO

AT : d_5

Ex.: (5) "Sakuban naito kurabu de kenka ga atta." 5;2;1

"There was a fight at the night club last night."

G.: IN

S.: EN

Ex.: (6) "Shinsa iinkai de toogi shita kekka..." 6;2;1

"As the result of the discussion at the meeting of the investigating committee..."

G.: IN

S.: En

Ex.: (7) "Kono hen de sankai ni shimashoo." 8;2;1

"Let's close the meeting at this point."

G.: BEI

S.: CON

Ex.: (8) "Tomu wa rokujuuhassai de shinda." 1;1;17

"Tom died at the age of sixty-eight.

G.: IN

S.: CON

Ex.: (9) "Gaishoo kaigi de Peru wa hantai shita." 20;2;1

"Peru was in opposition at the Conference of Foreign Ministers."

G.: AUF

S.: EN

BECAUSE OF : d_6

Ex.: (10) "Kaminari de nemurenakatta." 7;1;15

"I couldn't sleep because of the thunder."

G.: WEGEN

S.: A CAUSA DE

Ex.: (11) "Ame de ikenakatta." 7;3;15

"I couldn't go because of the rain."

G.: WEGEN

S.: A CAUSA DE

BY : d_7

Ex.: (12) "Roodoosha wo jikan de yatou." 2;2;16
"To hire a laborer by the hour."

G.: Ø (adverb)
S.: POR

Ex.: (13) "Niku wo kiroguramu de utte iru." 12;2;16
"They sell the meat by kilogram."

G.: Ø (adverb)
S.: POR

Ex.: (14) "Hai, dempoo de shirasemashita." 7;2;6
"Yes, I informed him by telegram."

G.: DURCH
S.: POR

Ex.: (15) "Boku hitori no shintai de keri wa tsuku." 4;2;6
"It will be brought to an end by my own effort."

G.: DURCH
S.: MEDIANTE

Ex.: (16) "Kaminari de go nin ga shiboo shita." 4;2;1
"Five people were killed by the lightning."

G.: BEI
S.: EN

Ex.: (17) "Kisha de ikimasu ka, kuruma de ikimasu ka?" 18;3;3
"Are you going by train or by car?

G.: MIT
S.: CON

BY MEANS OF : d_8

Ex.: (18) "Ningen wa shisoo wo kotoba de arawasu

koto ga dekiru." 8;2;6

"A human being can express his ideas by means of words."

G.: MIT

S.: CON

FOR : d_9

Ex.: (19) "Watakushi wa taipuraitaa wo jyuu Yen no sonryoo de karita." 14;2;12

"I hired the typewriter for ten Yen."

G.: FUR

S.: POR

FROM: d_{10}

Ex.: (20) "Omae ga sore wo kakushite iru koto wa kaoiro de wakaru yo." 7;1;7

"I know from your look that you hid it."

G.: AN

S.: POR

Ex.: (21) "Kare no sakuhin wa iroirona ten de hinan wo uketa." 1;2;7

"His works were criticised from many angles."

G.: VON - AUS

S.: DESDE

Ex.: (22) "Hiruma no tsukare de nemuke ga dete kita." 15;1;15

"I felt sleepy from my day's work."

G.: VON

S.: DEBIDO A

Ex.: (23) "Banana de tsukutta sake wa oishiikatta." 7;2;7

"The sake made <u>from</u> bananas was delicious."

G.: AUS

S.: DE

<u>IN</u> : d_{11}

Ex.: (24) "Mariko wa shinshitsu <u>de</u> naite iru." 1;2;1

"Mariko is crying <u>in</u> the bedroom."

G.: IN

S.: EN

Ex.: (25) "Amerika <u>de</u> sono hoohoo wo kenkyuu shite iru." 1;2;1

"They are investigating that method <u>in</u> the United States."

G.: IN

S.: EN

Ex.: (26) "Hyaku meetoru wo go-jyuu-go byoo <u>de</u> oyogu." 2;2;2

He can swim 100 meters <u>in</u> 55 seconds."

G.: IN

S.: EN

Ex.: (27) "Nifun <u>de</u> hachi ji ni naru." 2;1;2

"It will be 8 o'clock <u>in</u> two minutes."

G.: IN

S.: EN

Ex.: (28) "Okusama wa kago <u>de</u> oide ni narimashita." 3;3;3

"The lady has come <u>in</u> a palanquin."

G.: MIT

S.: EN

Ex.: (35) "Kono ringo wa mutsu de ikura desu ka?" 12;5;9

"How much do six of these apples cost?"

G.: Ø

S.: Ø

Ex.: (36) "Sore wa amari hade de kiraremasen." 13;2;5

"It is so showy that I cannot wear it."

G.: Ø

S.: Ø

Ex.: (37) "Kono harigane wa shaku de ikura desu ka?" 12;5;9

"How much a foot does this wire cost?"

G.: Ø

S.: Ø

Ex.: (38) "Doko de setomono wo yakimasu ka?" 1;2;1

"Where do they make pottery?"

G.: Ø

S.: Ø

Ex.: (39) "Oosaka made itto de oide desu ka?" 1;2;1

"Do you go to Oosaka first class?"

G.: Ø

S.: EN

OF : d_{13}

Ex.: (40) "Nihon no fujin de yoofuku wo kiru hito ga takusan iru." 6;2;11

"Many of the Japanese ladies wear foreign clothes."

G.: UNTER

S. DE

Ex.: (29) "Kare wa bimboo no donsoko de byooshi shita." 10;1;8

"He died of illness in extreme poverty."

G.: Ø

S.: EN

Ex.: (30) "Ringo wa ichiba de utte iru." 17;2;1

"Apples are sold in the market."

G.: AUF

S.: EN

Ø : d_{12}

Ex.: (31) "Koko de miotoshite wa naranai no wa, . . ." 1;2;1

"Here, the thing we shouldn't overlook is . . ."

G.: Ø

S.: Ø

Ex.: (32) "Oneesan wa byooki de nete imasu." 11;4;21

"My elder sister is ill in bed."

G.: Ø

S.: Ø

Ex.: (33) "Futari de yukkury seikatsu wo tanoshimu." 12;1;9

"The two enjoy a leisurely life."

G.: Ø

S.: Ø

Ex.: (34) "Tamago ryoori de ichiban oishii no wa, . . ." 7;2;10

"The most delicious dishes prepared from eggs are, ..."

G.: Ø

S.: Ø

Ex.: (41) "Taroo wa kekkaku de shinda." 15;1;14

"Taroo died of tuberculosis."

G.: AN

S.: CON

Ex.: (42) "Kono teeburu wa foomaikaa de tsukutta mono desu." 7;2;20

"This table is made of formica."

G.: AUS

S.: DE

ON : d_{14}

Ex.: (43) "Sono toki wa uma de ryokoo shita." 9;3;3

"Then they travelled on horseback."

G.: ZU

S.: A

Ex.: (44) "Michi de tomodachi ni aimashita." 19;1;1

"I met a friend on the street."

G.: AUF

S.: EN

Ex.: (45) "Tanaka kun wa nenkin de kurashite imasu." 7;1;6

"Mr. Tanaka is living on an annuity."

G.: VON

S.: DE

THROUGH : d_{15}

Ex.: (46) "booenkyoo de miru." 1;2;4

"to look <u>through</u> a telescope."

G.: DURCH

S.: POR

Ex.: (47) "Aitsu wa hiiki <u>de</u> shooshin shitanda." 4;2;5

"He has been promoted <u>through</u> favoritism."

G.: DURCH

S.: POR

<u>THROUGHOUT</u> : d_{16}

Ex.: (48) "Tetsuya <u>de</u> benkyoo shita." 2;2;15

"I studied <u>throughout</u> the night."

G.: GANZE - HINLURCH

S.: DURANTE TODO (A)

<u>WITH</u> : d_{17}

Ex.: (49) "Wesuto <u>de</u> choosetsu dekiru yooni tsukutte aru." 7;2;19

"It's designed to be operated <u>with</u> the hip."

G.: MIT

S.: CON

Ex.: (50) "Kare wa igan <u>de</u> nyuuin shita." 15;2;5

"He was hospitalized <u>with</u> cancer of the stomach."

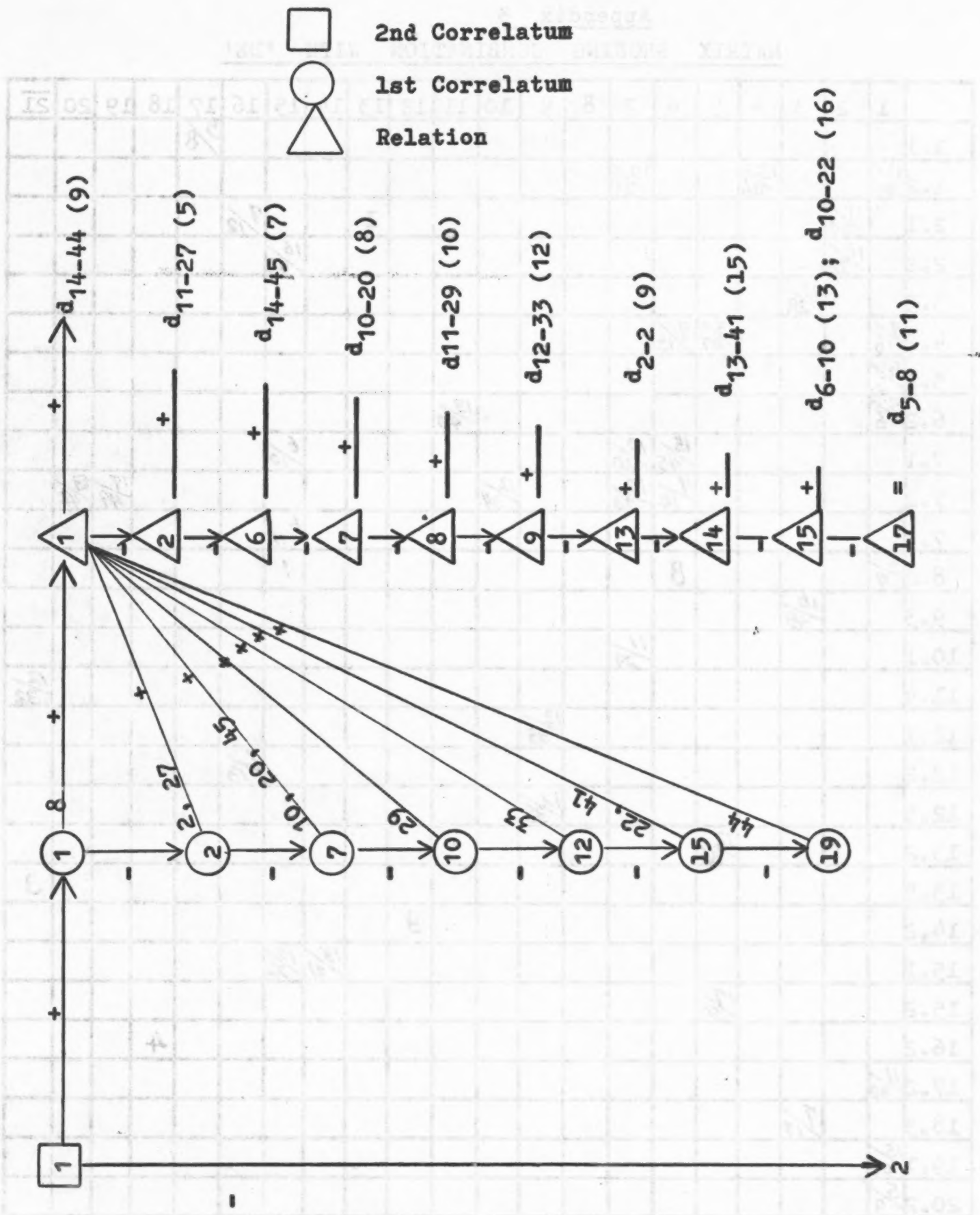
G.: WEGEN

S.: POR + INF.

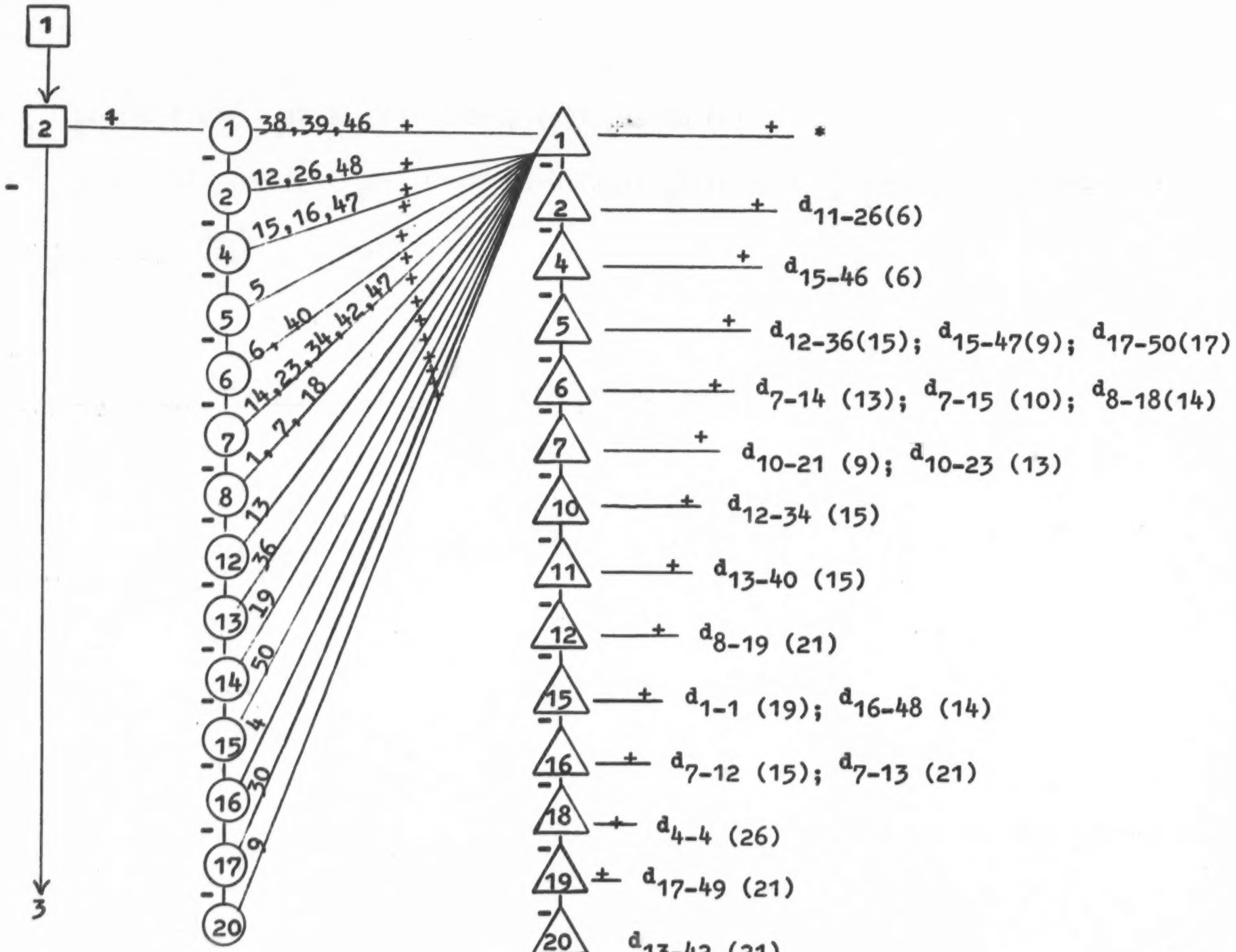
Appendix 3

MATRIX SHOWING COMBINATION WITH 'DE'

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1.1																	5/8				
1.2	11/24			15/46			10/21														
2.1		11/27											2			7/12					
2.2		11/26													16/48						
3.3			11/28																		
4.2	7/16				15/47	7/15															
5.2	5/5																				
6.2	5/6										13/40										
7.1						15/45	10/20								6/10						
7.2						7/14	10/23			13/34									17/49	13/42	
7.3															6/11						
8.2	5/7					8									1						
9.3			14/43																		
10.1							11/29														
11.4																					12/32
12.1									12/33												
12.2																7/13					
12.5									12/35												
13.2					12/36																
13.5																					3
14.2												9									
15.1														13/41	10/22						
15.2					17/50																
16.2																		4			
17.2	11/30																				
18.3			7/17																		
19.1	15/44																				
20.2	5/9																				


2nd Correlatum
1st Correlatum
Relation
d14-44 (9)
d11-27 (5)
d14-45 (7)
d10-20 (8)
d11-29 (10)
d12-33 (12)
d2-2 (9)
d13-41 (15)
d6-10 (13); d10-22 (16)
d5-8 (11)
2, 27
10, 20, 45
29
33
41, 22
44
2

Appendix 4


1
2
3
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38,39,46
12,26,48
15,16,47
5
6, 40
14,23,34,42,47
1, 7, 18
13
36
19
50
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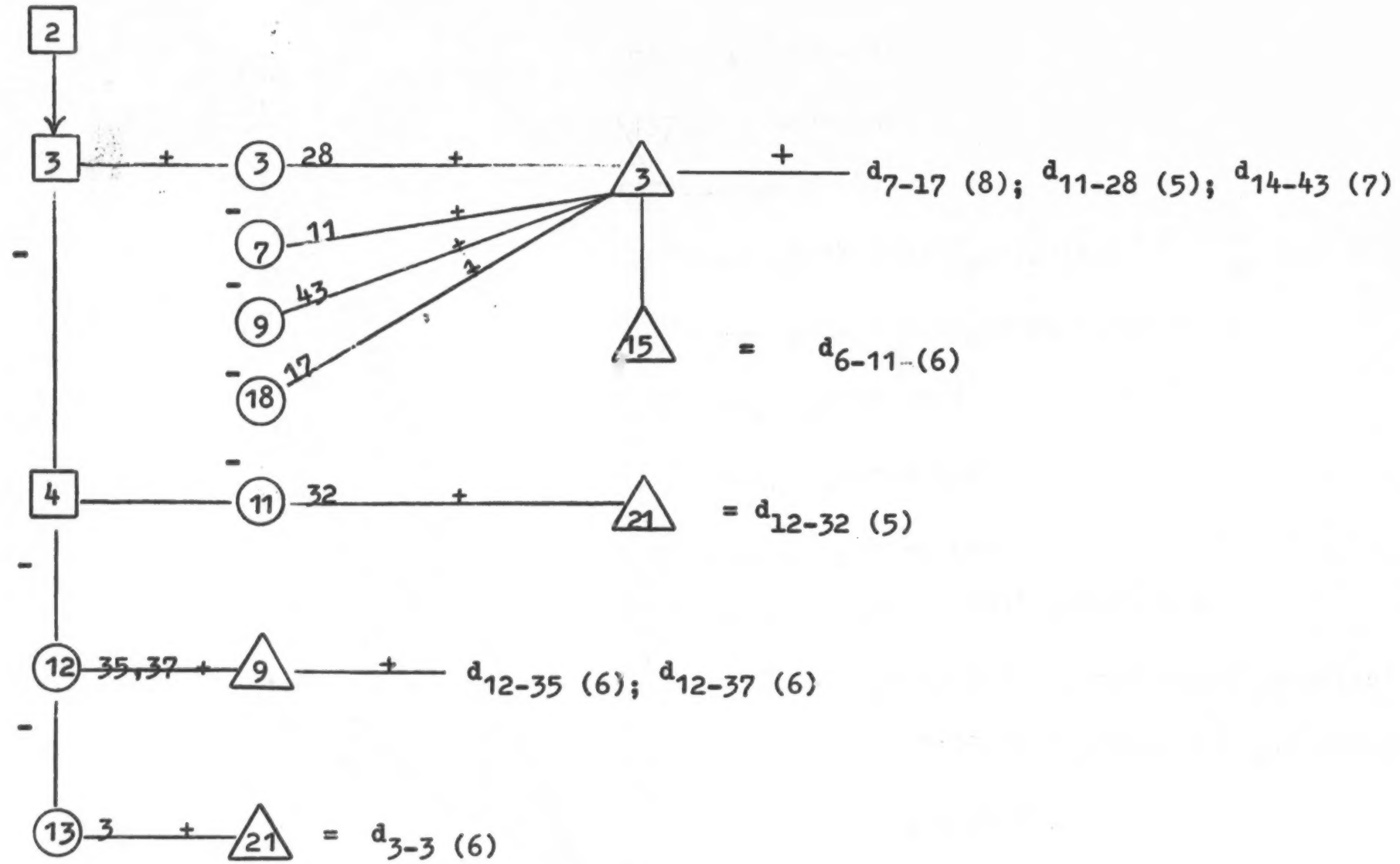
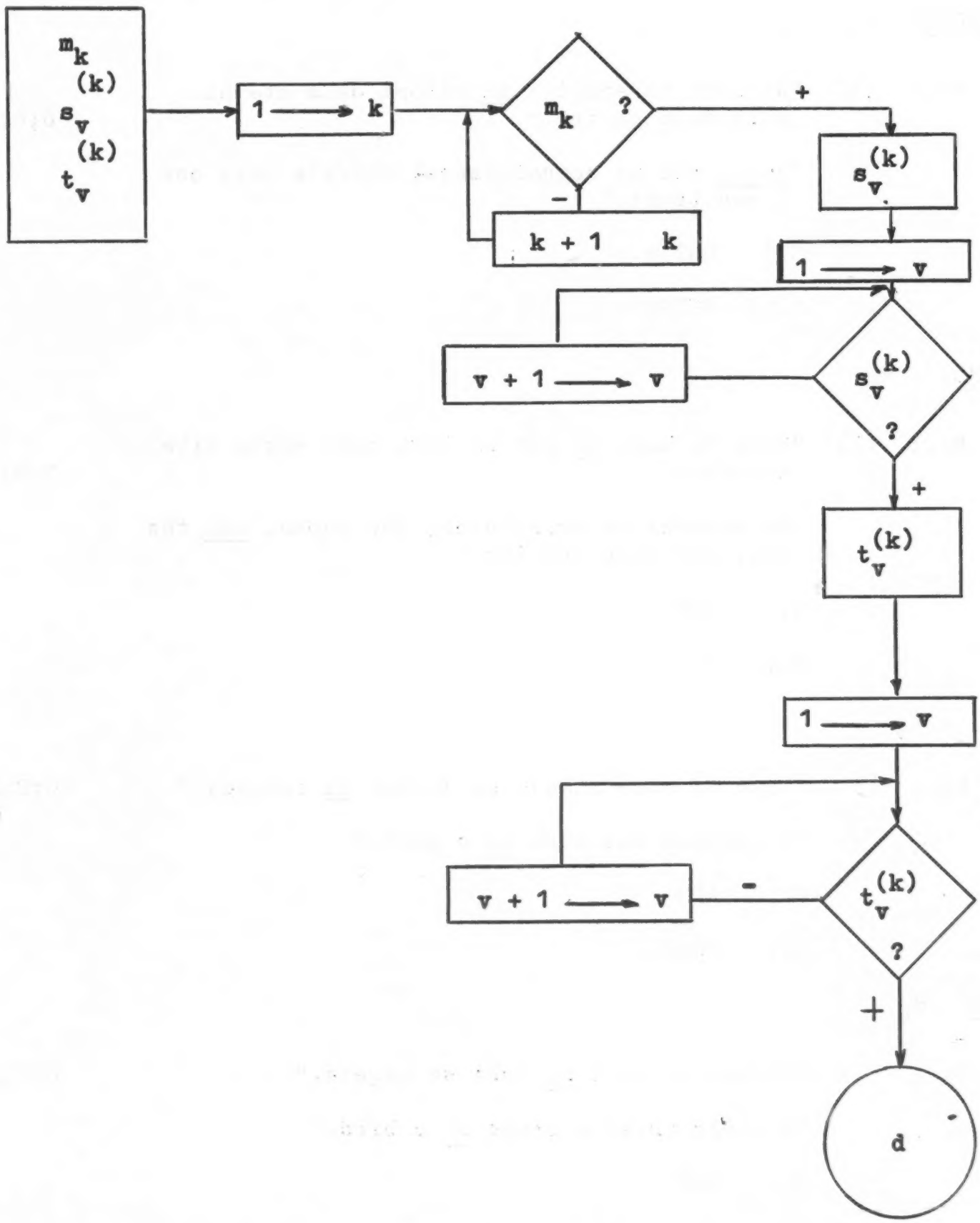
7
10
11
12
15
16
18
19
20
$d_{11-26(6)}$
d_{15-46} (6)
$d_{12-36(15)}$; $d_{15-47(9)}$; $d_{17-50(17)}$
d_{7-14} (13); d_{7-15} (10); $d_{8-18(14)}$
d_{10-21} (9); d_{10-23} (13)
d_{12-34} (15)
d_{13-40} (15)
d_{8-19} (21)
d_{1-1} (19); d_{16-48} (14)
d_{7-12} (15); d_{7-13} (21)
d_{4-4} (26)
d_{17-49} (21)
d_{13-42} (21)



* d_{5-5} (7); d_{5-6} (8); d_{5-7} (10); d_{5-9} (17); d_{5-16} (6); d_{11-24} (4); d_{11-25} (4); d_{11-30} (16); d_{12-31} (4); d_{12-38} (4); d_{12-39} (4)

Appendix 5



Algorithm showing the Production of Particle "DE"

Appendix 6 NI

AMONG: d_1

Ex.: (1) "Watashi no shiriai ni hitori dake ate ni naru mono ga iru." 6;6;10

"Among all my acquaintances, there's only one I can trust."

G.: UNTER

S.: ENTRE

AND: d_2

Ex.: (2) "Kare wa kami ni pen ni inku made motte kite kureta." 7;8;41

"He brought me everything, the paper, and the pen, and even the ink."

G.: UND

S.: Y

AS d_3

Ex.: (3) "Boku wa sono shoojo wo jochuu ni tanonda." 6;2;26

"I engaged the girl as a maid."

G.: ALS

S.: COMO

AT d_4

Ex.: (4) "Kodomo ga tori ni ishi wo nageta." 6;2;33

"A child threw a stone at a bird."

G.: AUF

S.: A

Ex.: (5) "Asu no gogo yoji ni ukgaimasu." 21;2;22

"I'll visit you at four tomorrow afternoon."

G.: UM

S.: A

Ex.: (6) "Hakone ni sunde iru tomodachi ga tegami wo yokoshita." 5;6;1

"A friend who is living at Hakone wrote me a letter."

G.: IN

S.: EN

Ex.: (7) "Asa no hachi ji goro kuukoo ni tsuita." 5;2;36

"I arrived at the airport around 8 o'clock in the morning."

G.: IN

S.: A

BETWEEN : d_5

Ex.: (8) "Shizuoka wa Nagoya to Tokyo no mannaka ni aru." 1;6;1

"Shizuoka lies halfway between Nagoya and Tokyo."

G.: UND

S.: EN

BY: d_6

Ex.: (9) "Kono ie wa 15 meetoru ni 10 meetoru no niwa ga aru." 12;7;16

"This house has a yard 15 meters by 10 meters."

G.: IDIOMATIC

S.: Por

EVEN: d_7

Ex.: (10) "Aki to iu ni atatakashi. 11;5;55

"Even they call it autumn, it's warm."

G.: OBWOHL

S.: AUNQUE

EVERY: d_8

Ex.: (11) "Orimpiku wa yonen ni ichido hirakaremasu." 2;2;47

"The Olympic games are held once every four years."

G.: Ø (ALLE)

S.: CADA

FOR: d_9

Ex.: (12) "Sorewa watashi ni tsugoo ga ii." 8;5;23

"It's convenient for me."

G.: FÜR

S.: PARA

Ex.: (13) "Kodomo ni shite wa yoku kaite arimasu ne!" 6;6;42

"It's very well written for a child, isn't it?"

G.: FÜR

S.: PARA

Ex.: (14) "Kore wa nani ni tsukaimasu ka?" 7;2;23

"What do you use this for?"

G.: ZU

S.: PARA

Ex.: (15) "Kono momo no nedan wa 100 Yen ni mitsu desu." 14;7;12

"The price of these peaches is 100 Yen for three."

G.: PRO

S.: POR CADA

Ex.: (16) "Sensei, anata ni tegami ga kite imasu yo". 6;2;23

"Sir, there is a letter for you."

G.: FÜR

S.: PARA

FROM : d_{10}

Ex.: (17) "Sore wa mokuhan ni sutta hoo ga yasui yo." 7;2;40

"It's cheaper if you make a print from a wood-engraving."

G.: VON

S.: DE

Ex.: (18) "Kare wa sono koto wo hito ni kakushita." 6;2;27

"He concealed the matter from the others."

G.: VOR

S.: ANTE

Ex.: (19) "Kono tebukuro wa oji ni itadaita." 6;2;7

"I received these gloves from my uncle."

G.: VON

S.: DE

IN : d_{11}

Ex.: (20) "Nippon wa tennen shigen ni toboshii." 7;5;48

"Japan is poor <u>in</u> natural resources."

G.: AN

S.: EN

Ex.: (21) "Imooto wa Tokyo <u>ni</u> sunde imasu." 22;6;1

"My sister is living <u>in</u> Tokyo."

G.: IN

S.: EN

Ex.: (22) "Taiyoo wa nishi <u>ni</u> kureru." 24;1;1

"The sun sets <u>in</u> the west."

G.: IN

S.: POR

Ex.: (23) "Masako san wa amefuri <u>ni</u> dekaketa." 4;3;30

"Miss Masako went out <u>in</u> the rain."

G.: BEI

S.: CUANDO

Ex.: (24) "Kuuchuu <u>ni</u> tobu tori mo mina kami no zoobutsu de aru." 7;6;1

"All the birds flying <u>in</u> the air are also creatures of God."

G.: IN

S.: POR

Ex.: (25) "Okane wo minna kinkoo <u>ni</u> ireta." 7;2;32

"I put all the money in a safe."

G.: IN

S.: EN

IN FRONT OF : d_{12}

Ex.: (26) "Ie no mae ni ogawa ga nagarete iru." 1;6;39

"A brook trickles down in front of the house."

G.: VOR

S.: DELANTE DE

INTO: d_{13}

Ex.: (27) "Masako wa amefuri ni gaishutsu shita." 4;3;32

"Masako went out into the rain."

G.: IN - HINAUS

S.: A

Ex.: (28) "Doozo kono tegami wo eigo ni yakushinasai." 8;2;32

"Please, translate this letter into English."

G.: IN

S.: A

Ex.: (29) "Koori ga mizu ni naru." 7;1;31

"Ice turns into water."

G.: ZU

S.: EN

LIKE : d_{14}

Ex.: (30) "Taroo wa haha ni nite iru." 6;6;43

"Taroo looks like his mother."

G.: Ø

S.: A

Ex.: (31) "Kin ni mieru." 7;6;43

"It looks like gold."

G.: WIE

S.: Ø

Ø d_{15}

Ex.: (32) "Kanojo wa kaimono ni dekaketa." 4;3;23

"She went out shopping."

G.: ZU

S.: DE

Ex.: (33) "Doozo watashi ni kamawanai de kudasai!" 6;2;25

"Please leave me alone."

G.: Ø

S.: Ø

Ex.: (34) "Tori ni hane ga ari, ushi ni tsuno ga aru." 6;6;1

"Birds have wings and oxen have horns."

G.: Ø

S.: Ø

Ex.: (35) "Haha ga ko ni kusuri wo nomaseta." 6;2;54

"The mother had the child drink medicine."

(Causative use)

G.: Ø

S.: A

Ex.: (36) "Haneda e tomodachi wo demukae ni iku yo." 4;3;25

"I'm going to meet a friend at Haneda."

G.: 9

S.: ø

Ex.: (37) "Hitori ni jyuu Yen no kokorozuke wo yatta." 6;2;46

"I gave each person a tip of ten Yen."

G.: ø

S.: A

Ex.: (38) "Sensei ni shitsumon shinakereba narimasen." 6;2;25

"I must ask my teacher a question."

G.: ø

S.: A

S.: A

OF: d_{16}

Ex.: (39) "Korera no ringo ni oishii nomo mazui nomo arimasu." 7;5;10

"Of these apples, some taste good, some bad."

G.: VON

S.: DE

Ex.: (40) "Kare no sei wa rokushaku ni sansun tarinai." 12;7;45

"He's three inches short of six feet."

G.: ZU

S.: PARA

ON : d_{17}

Ex.: (41) "Rondon wa Teemusu kahan ni aru." 23;6;1

"London is situated on the Thames."

G.: AN

S.: A ORILLAS DE

Ex.: (42) "Nimotsu wo tana ni oita." 7;2;34

"I put the baggage on a shelf."

G.: AUF

S.: EN

Ex.: (43) "Kare wa tsukue ni motarete ita." 7;6;35

"He was leaning on the desk."

G.: AN

S.: EN

Ex.: (44) "Tooka no asa ni ryokoo kara kaetta." 2;2;22

"He returned from his journey on the morning of 10th."

G.: AN

S.: Ø

Ex.: (45) "Amozon gawa ni musuu no ikada ga ukande ita." 7;1;34

"Countless rafts were floating on the river Amazon."

G.: AUF

S.: SOBRE

OVER : d_{18}

Ex.: (46) "Taroo wa me ni hootai wo shite gakkoo ni kita." 7;6;37

"Taroo came to school with a bandage over his eyes."

G.: UBER

S.: SOBRE

TO: d_{19}

Ex.: (47) "Yokohama wa Tokyoo no nishi ni aru." 1;6;38

"Yokohama lies to the west of Tokyo."

G.: IN

S.: AL

Ex.: (48) "Oya to wakarete America ni watatta." 1;3;36

"He parted from his parents and went to the States."

G.: NACH

S.: A

Ex.: (49) "'A' wa 'B' ni hitoshii." 7;5;43

"'A' is equal to 'B'."

G.: Ø

S.: A

Ex.: (50) "San ni go wo taseba hachi desu." 12;7;24

"If you add five to three, it makes eight."

G.: ZU

S.: A

Ex.: (51) "Kono to ni kagi wa arimasen ka?" 7;6;23

"Isn't there a key to this door?"

G.: ZU

S.: PARA

Ex.: (52) "Mon no migigawa ni hyoosatsu wo dasu." 5;2;38

"He puts up a name-plate to the right of the gate."

G.: Ø

S.: A

Ex.: (53) "Kanojo wa tomodachi ni hanashikaketa." 6;2;28

"She spoke to her friend."

G.: MIT

S.: CON

TOWARD : d_{20}

Ex.: (54) "Karera wa taiyoo ni mukatte oganda." 7;2;44

"They turned toward the sun and worshipped it."

G.: ZU

S.: HACIA

WITH : d_{21}

Ex.: (55) "Nagano-kun wa kono jiken ni kankei shite iru." 7;6;29

"Mr. Nagano is connected with this incident."

G.: IN

S.: EN

Ex.: (56) "Abura wa mizu ni majiranai." 7;1;24

"Oil does not mix with water."

G.: MIT

S.: CON

MATRIX SHOWING COMBINATION WITH 'NI'

	1	7	10	12	16	22	23	24	25	26	27	28	
1;3													
1;6	5/8												
2;2						17/44							
4;3							15/32		15/36				
5;2													
5;6	4/6												
6;2		10/19					9/16		15/33	3/3	10/18	19/53	
6;6	15/34		1/1										
7;1								21/56					
7;2							9/14						
7;5			16/39										
7;6	11/24						19/51						
7;8													
8;2													
8;5							9/12						
11;5													
12;7					6/9			19/50					
14;7				9/15									
21;2						4/5							
22;6	11/21												
23;6	17/41												
24;1	11/22												

Appendix 7

	29	30	31	32	33	34	35	36	37	38	39
1;3								19/48			
1;6										19/47	12/26
2;2											
4;3		11/23		13/27							
5;2								4/7		19/52	
5;6											
6;2					4/4						
6;6											
7;1			13/29			17/45					
7;2				11/25		17/42					
7;5											
7;6	21/55						17/43		18/46		
7;8											
8;2				13/28							
8;5											
11;5											
12;7											
14;7											
21;2											
22;6											
23;6											
24;1											

	40	41	42	43	44	45	46	47	48	54	55
1;3											
1;6											
2;2								8/11			
4;3											
5;2											
5;6											
6;2							15/37			15/35	
6;6			9/13	14 30							
7;1											
7;2	10/17				20/54						
7;5				19/49					11/20		
7;6				14/31							
7;8		2/2									
8;2											
8;5											
11;5											7/10
12;7						16/40					
14;7											
21;2											
22;6											
23;6											
24;1											

AMONG : d_1

Ex.: (1) "Kare mo shishoosha no suu e kazoerareta." 8;10;56

"He was also numbered among the casualties."

G.: UNTER

S.: ENTRE

AT : d_2

Ex.: (2) "Otoosan wa kyookai e itte imasu." 25;6;1

"Father is at church."

G.: ZU ; IN

S.: A

BY : d_3

Ex.: (3) "Kanojo wa toranku wo bench no waki e oita." 5;2;38

"She put the trunk by the bench."

G.: ZU

S.: JUNTO A

FOR : d_4

Ex.: (4) ""Seihoo e susumu to soko ni numa ga arimasu." 24;3;38

"If you go on for the west, there is a marsh."

G.: NACH

S.: HACIA

FROM : d_5

Ex.: (5) "Boku wa sono kikai wo Nippon e chuumon shita." 1;2;7

"I ordered the machine from Japan."

G.: AUS

S.: A

IN : d_6

Ex.: (6) "Naze kono ita e ana wo akemasen ka?" 7;2;33

"Why don't you make a hole in this board?"

G.: IN

S.: EN

Ex.: (7) "Kare wa sabaku no naka e torinokosareta." 1;2;27

"He was left in the desert."

G.: IN

S.: EN

INTO: d_7

Ex.: (8) "Kuwaete ita niku wa hoeta totan ni kawa e ochita." 23;2;50

"As the dog barked, the meat which was in his mouth fell into the river."

Ø d_8

Ex.: (9) "Dochira e irasshaimasu ka?" 26;3;26

"Where are you going?" Ø

G.: Ø

S.: Ø;(A)

ON : d_9

Ex.: (10) "Ima anat ga itta koto wo kami e kakinasai." 7;2;37

"Please write down on a piece of paper what you have just said."

G.: AUF

S.: EN

Ex.: (11) "Jiten wo tana e okinasai." 7;2;34

"Put the dictionary on the shelf."

G.: AUF

S.: EN

OVER: d_{10}

Ex.: (12) "Mukoo e ikinasai." 26;3;36

"Go over there!"

G.: HINÜBER; HIN

S.: Ø

TO: d_{11}

Ex.: (13) "Asu Oosaka e iku tsumori da." 22;3;38

"I'm going to go to Osaka tomorrow."

G.: NACH

S.: A

Ex.: (14) "Kare wa zaisan wo kodomo e yuzuru deshoo." 7;2;25

"He will transfer his fortune to his son."

G.: AN

S.: A

TOWARD : d_{12}

Ex.: (15) "Konnichi daigaku e susumu michi wa hiroku akerarete iru." 1;2;25

"Today, the road toward the University is fully open."

G.: ZU

S.: A

WITH: d_{13}

Ex.: (16) "Arai san wa rikugun e gyuuniku wo osamete iru." 6;2;25

"Mr. Ari supplies the Army with beef."

G.: AN

S.: A

Appendix 9

MATRIX SHOWING COMBINATION WITH 'E'

	1	7	25	26	27	33	34	36	37	38	50	56
1;2		5/5	12/15		6/7							
5;2										3/3		
6;2			13/16									
7;2			11/14			6/6	9/11		9/10			
8;10												1/1
22;13										11/13		
23;2											7/8	
24;3										4/4		
25;6	2/2											
26;3				8/9				10/12				

Appendix 10 WO

AT : d_1

Ex.: (1) "Hanako -san wa hana wo mite imasu." 7;1;25

"Miss Hanako is looking at the flowers."

G.: ϕ

S.: ϕ

Ex.: (2) "Doozo, san peiji wo akenasai." 7;2;25

"Please open the book at page three."

G.: AUF

S.: EN

Ex.: (3) "Kare wa kanojo no booshi wo warau." 7;2;15

"He laughs at her hat."

G.: ÜBER

S.: DE

Ex.: (4) Karera wa shoori wo yorokonde iru." 4;2;15

"They are rejoicing at the victory."

G.: ÜBER

S.: DE

BY : d_2

Ex.: (5) Kare wa doroboo no ude wo tsukamaeta." 7;2;58

"He caught the thief by the arm.

G.: AN

S.: POR

FOR : d_3

Ex.: (6) "Kimi wa kare no tsumi wo azakerunja nai yo." 8;2;15

"You shouldn't blame him for his fault."

G.: FÜR

S.: POR

Ex.: (7) "Kare wa anata no enjo wo kitai shita." 7;2;61

"He longed for your help."

G.: NACH

S.: POR

Ex.: (8) "Kono kooji wa seifu no hojo wo aoganakereba naranai." 7;2;51

"We have to ask for government aid for this work."

G.: UM

S.: Ø

Ex.: (9) "Nippon wa tetsu no kyookyuu wo nambei ni motomeru." 7;1;52

Japan looks to South America for her supply of iron."

G.: UM

S.: POR

FROM : d_4

Ex.: (10) "Jiroo wa abunai tokoro wo tasukatta." 7;2;27

"Jiroo escaped from a dangerous situation."

G.: VON

S.: DE

Ex.: (11) "Nitchuu wa nakanaka atsui kara hi wo sakenasai." 1;2;27

"It's very hot in the daytime, so shelter yourself from the sun."

G.: IN

S.: EN

Ex.: (12) "Kare wa Tokyo wo shuppatsu shite Hiroshima e mukatta." 4;2;27

"He started (out) from Tokyo and headed for Hiroshima."

G.: Ø

S.: DE

IN: d_5

Ex.: (13) "Hatchi ga Hanako no yubi wo sashita." 7;2;32

"A bee stung Hanako in the finger."

G.: IN

S.: EN

Ex.: (14) "Tori wa sora wo tobu." 1;11;1

"Birds fly in the air."

G.: IN

S.: EN

Ex.: (15) Ichinichijuu daidokoro wo ukemotsu." 1;2;1

"All day long I work in the kitchen."

G.: IN

S.: EN

INTO : d_6

Ex.: (16) "Ame no naka wo kasa mo sasanaide dete itta." 7;3;50

" He went out into the rain without putting up his umbrella."

G.: IN

S.: A

Ø : d_7

Ex.: (17) "Chichi wa gamaguchi wo nusumareta." 6;1;53

"Somebody stole my father's purse."

G.: Ø

S.: Ø

Ex.: (18) "Kanojo wa hon wo kaimashita." 7;2;52

"She bought a book."

G.: Ø

S.: Ø

Ex.: (19) "Inochi bakari wa otasuke wo!" 27;Ø;57

"Only spare my life!"

G.: Ø

S.: QUE

OF : d_8

Ex.: (20) "Hi wo ki wo tsukenasai." 7;2; 27

"Be careful of the fire."

G.: AUF

S.: CON

Ex.: (21) "Hanako wa kare ni koi wo katatta." 8;2;25

"Hanako spoke to him of love."

G.: VON

S.: DE

Ex.: (22) "Watashi wa itsumo anata wo omoimasu." 6;1;25

"I'm always thinking of you."

G.: AN

S.: DE

OFF : d_9

Ex.: (23) "Kare wa Numzu de kisha wo orita." 7;3;28

"He got off the train at Numazu."

G.: AUS

S.: DE

ON : d_{10}

Ex.: (24) "Michi wo aruku toki . . . ." 1;3;34

"When you walk on the street, . . ."

G.: AUF

S.: EN

Ex.: (25) "Boku wa Taroo no atama wo utte yatta." 7;2;34

"I hit Taroo on the head."

G.: AUF

S.: EN

Ex.: (26) "Kare wa natsuyasumi wo asobi ni itta." 4;2;25

"He is enjoying himself on his summer vacation."

G.: AUF

S.: EN

OUT OF : d_{11}

Ex.: (27) "Taroo wa ie wo deta." 1;3;27

"Taroo went out of the house."

G.: AUS

S.: DE

OVER : d_{12}

Ex.: (28) "Karera wa saki wo arasotta." 1;2;44

"They fought over the front place."

G.: UM

S.: POR

Ex.: (29) "Watashitachi wa hashi wo wataru." 19;3;60

"We cross over the bridge."

G.: ÜBER: ø

S.: ø

THAT : d_{13}

Ex.: (30) "Watashi wo kyoojin datte iuu no yo." 6;2;59

"He says that I am a lunatic."

G.: DASS - Clause

S.: QUE - Clause

THROUGH: d_{14}

Ex.: (31) "Jiroo wa gunshuu wo oshiwakete susunda." 6;3;50

"Jiroo pushed his way through the crowd."

G.: DURCH

S.: POR

TO: d_{15}

Ex.: (32) "Kore ga kare no seikoo wo tasuketa." 4;1;54

"This contributed to his success."

G.: ZU

S.: A

WITH : d_{16}

Ex.: (33) "Hanji wa hito wo koohei ni toriatsukau." 6;2;25

"A Judge deals justly with all men."

G.: Ø

S.: A

Ex.: (34) "Hito wa kare wo aite ni shinai." 6;2;25

"People will have no dealings with him."

G.: MIT

S.: CON

Ex.: (35) "Kare wa Hanako ni amai kotoba wo kaketa." 8;2;51

"He overwhelmed Hanako with sweet words."

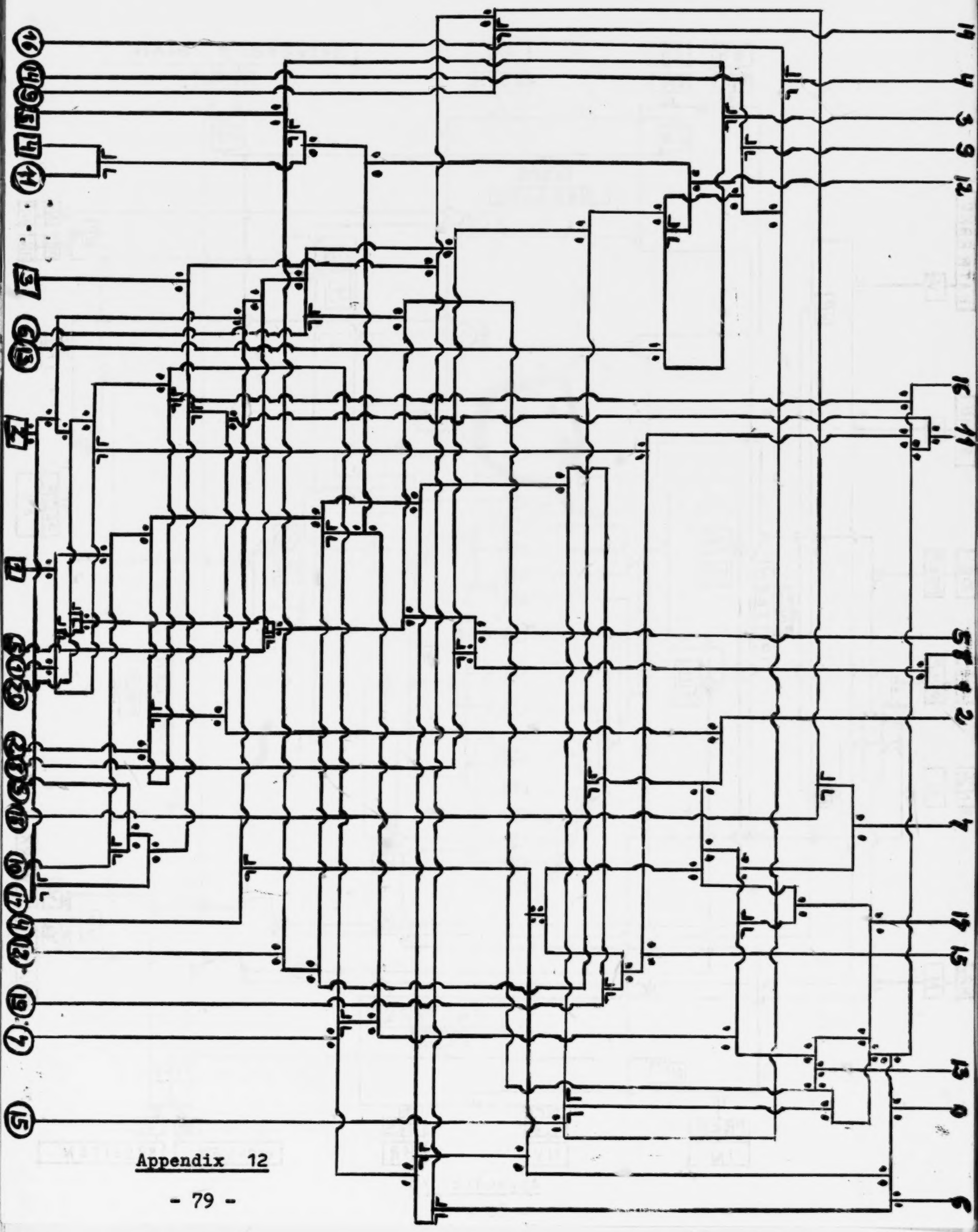
G.: MIT

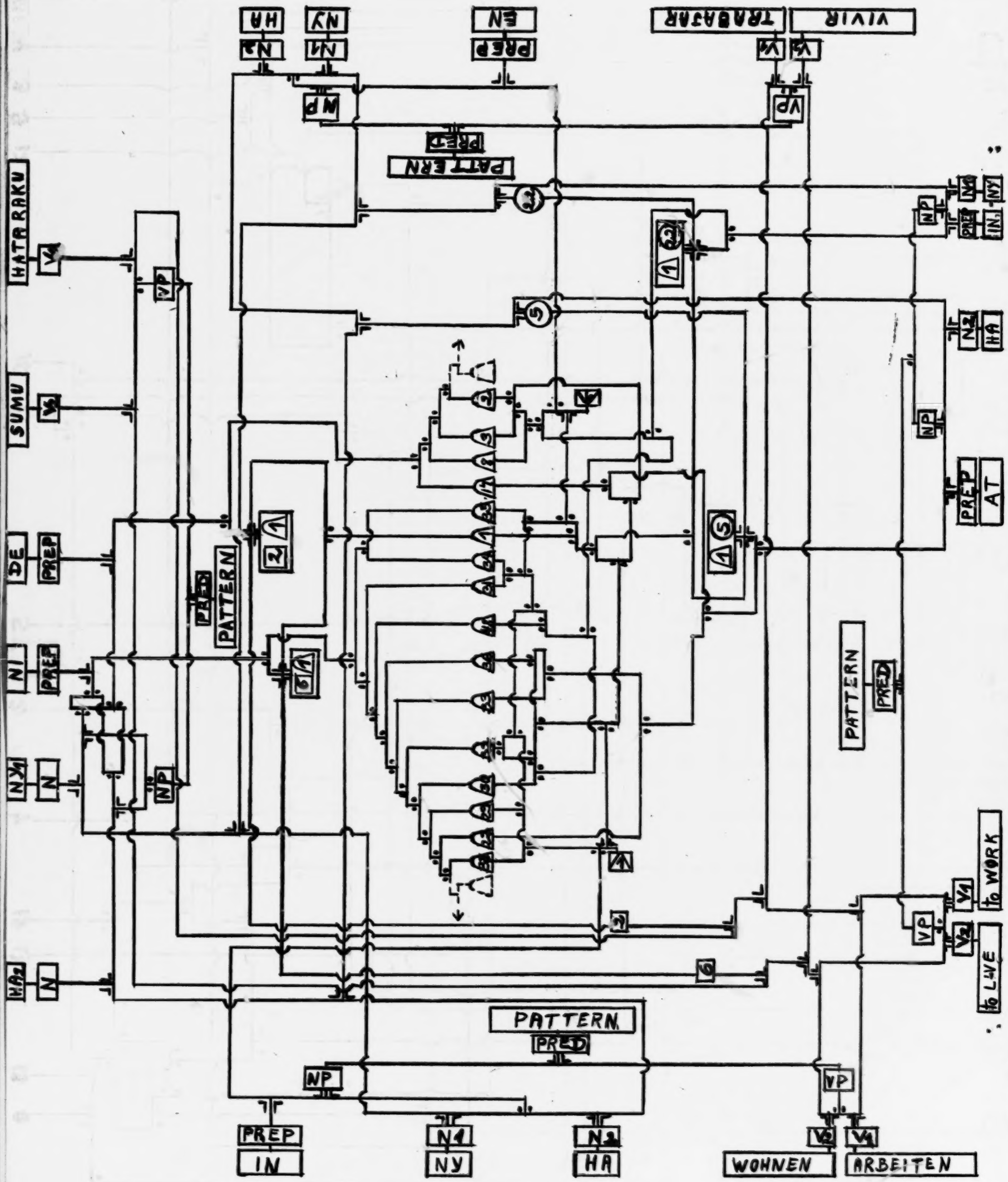
S.: CON

Appendix 11

MATRIX SHOWING COMBINATION WITH 'WO'

	1	5	15	25	27	28	32	34	44	50	51	52	53	54	57	58	59	60	61
1;2	5/15				4/11				12/28										
1;3					11/27														
1;11	5/14																		
4;1														15/32					
4;2			1/4	9/26	4/12														
6;1				8/22									7/17						
6;2				16/33 16/34													13/30		
6;3										14/31									
7;1				1/1	8/20							3/9							3/7
7;2			1/3	1/2	4/10		5/13	10/25			3/8	7/18				2/5			
7;3						9/23				6/16									
8;2			3/6	8/21							16/35								
19;3								10/24										12/29	
27;0															7/19				




WOHNEN
ARBEITEN
PREP
IN
N1
NY
N2
HA
PATTERN
PRED
NP
VP
V2
V1
to WORK
to LIVE
PATTERN
PRED
PREP
AT
NP
N2
HA
NP
IN
NY
VP
V2
V1
TRABAJAR
VIVIR
PREP
EN
N1
N2
HA
PATTERN
PRED
NP
VP
V2
V1
HATARAKU
SUMU
DE
PREP
PATTERN
PRED
N1
PREP
NX1
N
NP
HA2
N

Appendix 13

References and Foot Notes

1) E. V. Glasersfeld : "Multistore" - A procedure for Correlational Analysis, Informal Report ILRS - T11, 650120, January 1965, IDAMI Language Research Section, Milan, Italy

2) In this example we neglect the correlator NI contained within the 2nd correlatum.

3) Cf.: N. Naganuma: Grammar and Glossary, Tokyo, 1951, P. 40

4) Cf.: Weisgerber: Die vier Stufen in der Erforschung der Sprache, Düsseldorf, 1963, S. 260 ff.

   Cf.: A. Hoppe: Die mashinelle Uebersetzung von sprachlichen Inhalten, die nicht ausgesprochen werden - en Sprache im Technischen Zeitalter, No. 23, July-Sept., 1967

5) Cf.: F. V. Cube, Was ist Kybernetick?, Bremen 1967, p. 135 - 140

6) Cf.: E. V. Glasersfeld : "Multistore" etc. op. cit.

7) Cf.: A. Hoppe: Der sprachliche Forulierungsprozess als Grundlage automatisher Hin - und Her - Ubersetzung in Neuere Ergebnisse der Kybernetik, München 1964

8) Cf.: A. Hoppe: Die mashinelle Uebersetzung, etc. op. cit.

9) Cf.: Th. R. Hofmann: Underlying vs. Superficial Grammatical Relations in "Mechanical Translation Project", 11th Semester Report, October 31, 1968, Université de Montréal

   Cf. also: A Hoppe: Der sprachliche, etc. op. cit.

10) Cf.: E. Zierer, K. Lee and Aníbal Sánchez: A comparative Study of Yngve's Depth Hypothesis, Trujillo, Peru may 1967